Standards and Monitoring Results

The Clean Air Act of 1970 required the United States Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for each air pollutant anticipated to endanger public health or welfare. Pollutants in this category, termed criteria pollutants, included: total suspended particulate, lead, sulfur dioxide, carbon monoxide, ozone, and nitrogen dioxide.

In 1987, total suspended particulate (TSP) was replaced by particulate matter less than 10 microns (1/100 of a millimeter) in diameter (PM_{10}). On July 18, 1997, both the ozone and particulate standards were revised by the EPA. In addition, a new standard for particulate matter with a diameter of less than 2.5 microns ($PM_{2.5}$) was introduced. However, the new standards were challenged in court. In May 1999, the U.S. Court of Appeals for the District of Columbia Circuit declared that the new standards are not enforceable. Therefore, the standards could not be implemented at that time. In February of 2001, the Supreme Court ruled in favor of EPA and remanded the case back to the D.C. Court of Appeals for a final decision.

The current Air Quality Standards are summarized by pollutant in the table on page 14. As shown in the table, there are two types of air quality standards. The primary standard is designed to protect the public health with an adequate safety margin. Permissible levels were chosen to protect the health of the most susceptible individuals in a population, including children, the elderly, and those with chronic respiratory ailments. The secondary standard is designed to protect public welfare or ensure quality of life. Air quality conditions described by the secondary standard may be the same as the primary standard and are chosen to limit economic damage as well as harmful effects to buildings, plants, and animals.


Photo by: Tom Gross, KDHE

During 2000, the Kansas Ambient Air Monitoring Program measured five of the six criteria air pollutants. Monitoring for the sixth, lead, was phased out during 1998, due in large part to the significant drop in measured values caused by the elimination of leaded gas.

Statewide summaries for each of the five criteria pollutants measured in 2000 appear below. Information for each pollutant is included in the narratives that accompany the pollutant graphs.

Sulfur Dioxide (SO_2)

Sulfur dioxide (SO_2) is a colorless, nonflammable gas that enters the atmosphere primarily from the combustion of sulfur-laden fossil fuels such as coal and oil. Other man-made sources of SO_2 emissions include commercial production of sulfuric acid and fuel combustion in vehicles. Most naturally emitted SO_2 results from hydrogen sulfide (H_2S) produced during biological decay of organic matter.

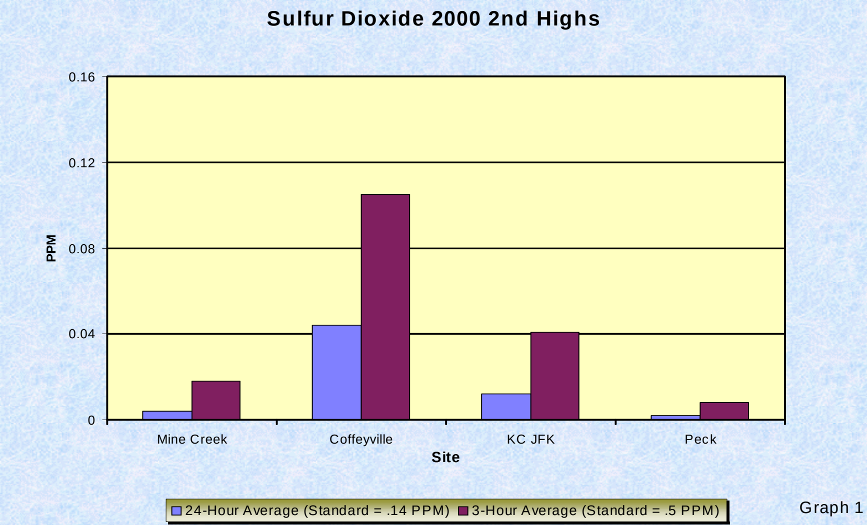
High concentrations of SO_2 can result in temporary breathing problems for asthmatic people who are active outdoors.

National Ambient Air Quality Standards

Criteria Air Pollutant	Averaging Time	Primary Standard	Secondary Standard
Carbon Monoxide	One-hour maximum[a]	35 ppm[c] (40 mg/m^3[b])	
	Eight-hour maximum[a]	9 ppm (10 mg/m^3)	
Lead	Quarterly Average	1.5 ug/m^3[d]	Same as Primary Standard
Nitrogen Dioxide	Annual Arithmetic Mean	0.053 ppm (100 ug/m^3)	Same as Primary Standard
Ozone *	One-hour average[a]	0.12 ppm (235 ug/m^3)	Same as Primary Standard
	Eight-hour average[e]	0.08 ppm (157 ug/m^3)	Same as Primary Standard
Particulate Matter * (PM_{10})	Annual Arithmetic Mean 24-hour average[f]	50 ug/m^3 150 ug/m^3	Same as Primary Standard
Particulate Matter * ($PM_{2.5}$)	Annual Arithmetic Mean[g] 24-hour average[h]	15 ug/m^3 65 ug/m^3	Same as Primary Standard
Sulfur Dioxide	24-hour maximum[a]	0.14 ppm (365 ug/m^3)	
	Annual Arithmetic Mean	0.03 ppm (80 ug/m^3)	
	Three-hour Maximum[a]		0.5 ppm (1300 ug/m^3)

[a] Not to be exceeded more than once a year for primary and secondary standards
[b] mg/m^3 = milligrams per cubic meter
[c] ppm = parts per million
[d] ug/m^3 = micrograms per cubic meter
[e] Established for a three-year average of the fourth highest daily maximum concentration
[f] Established for a three-year average of the 99th percentile of data
[g] Established for a three-year average
[h] Established for a three-year average of the 98th percentile of data
* Pending the outcome of court decisions.

In what year was the Federal Clean Air Act last amended? a. 1989 b. 1978 c. 1990 d. 1995 (Answers on inside back cover).



Graph 1

Short-term exposures of asthmatic individuals to elevated SO_2 levels while at moderate exertion may result in breathing difficulties that may be accompanied by such symptoms as wheezing, chest tightness, or shortness of breath.

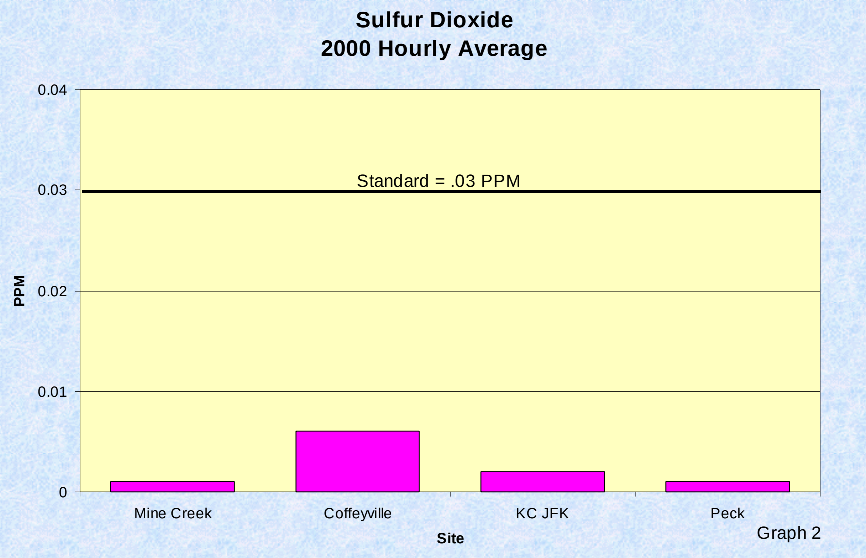
SO_2 can directly affect human health and the environment, or cause indirect effects upon conversion to sulfuric acid in the atmosphere. The leaves of many species of trees and other plants, including spinach, lettuce, and other leafy vegetables may be injured by SO_2 exposure. Acidification of ponds and lakes due, at least in part to the effects of sulfuric acid, can have major detrimental impact on aquatic life. Sulfuric acid also damages limestone, marble, roofing slate, and mortar.

In Kansas, transport of SO_2 beyond the vicinity of its sources is usually insignificant. Typically, SO_2 plumes are well dispersed and contribute only to background concentrations.

Sulfate particles formed by the oxidation of SO_2 are, however, subject to long-range transport in the atmosphere. In addition to their potential adverse health effects, these particles, generally less than 1.0 micron in diameter, are effective in scattering visible light, thus producing haze and reducing visibility.

RESULTS:

The primary air quality standard for SO_2 is expressed in three forms: an hourly average value; a 3-hour value not to be exceeded more than once per year; and a 24-hour value not to be exceeded more than once per year. Graph number 1 shows the 2nd highest 3-hour and 24-hour average results for the four sites. Graph number 2 shows the hourly average value concentrations for the four sites where SO_2 was monitored in Kansas during 2000. All four sites were well below the hourly average standard, 3-hour, and the 24-hour standard for SO_2. The Coffeyville site shows the highest concentration for all forms of the standard due to the proximity of the site to industrial sources of SO_2.



Graph 2

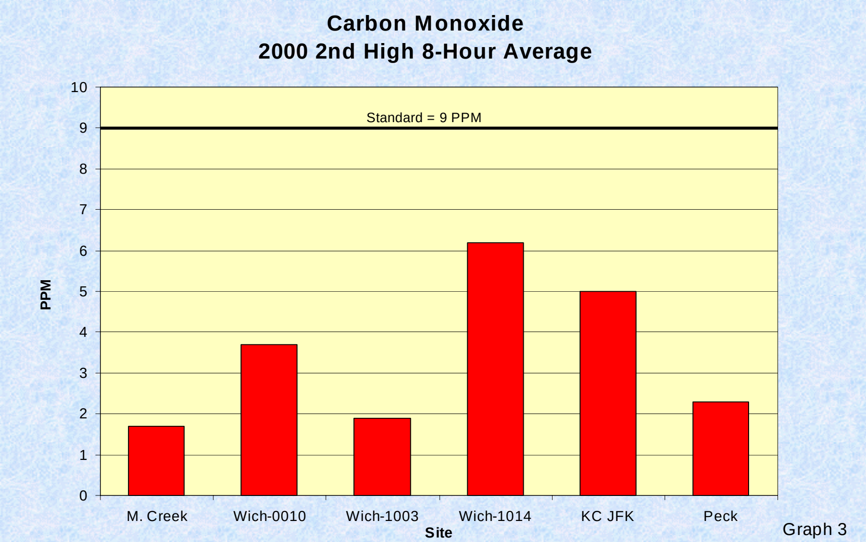
Carbon Monoxide (CO)

Carbon monoxide (CO) is a colorless, odorless, tasteless gas that is emitted into the atmosphere from both natural and man-made sources. Carbon monoxide enters the bloodstream through the lungs and reduces oxygen delivery to the body's organs and tissues. Symptoms of exposure to CO include dizziness, headache, and lethargy. Prolonged exposure to high levels of CO causes severe physical and pathological changes, and ultimately death.

The major natural source of CO is oxidation of methane. Other natural sources include the oceans; plant synthesis and degradation; oxidation of terpenes (from certain plant species); and forest or prairie fires. On a global scale, natural sources account for nearly 90% of CO emissions. Man-made CO is emitted chiefly as a product of combustion of gasoline, wood, natural gas, or coal. Elevated CO levels occur primarily in urban areas as a result of emissions from motor vehicles. Other sources include fuel combustion for industrial and utility boilers, industrial process losses, and open burning.

Carbon monoxide from combustion sources is formed by incomplete burning of carbon-based fuel. Motor vehicles operating at low idle speeds tend to emit the highest levels of CO. As vehicle speed increases, emission of CO generally decreases.

Automotive carbon monoxide emissions also vary with ambient air temperature. Engines operate less efficiently in lower air temperatures, thus producing higher CO emissions. Carbon monoxide emissions tend to disperse due to the small amount of emissions from each engine and widespread nature of the emissions. Transport is not, therefore, considered an important factor in the occurrence of elevated ambient air concentrations beyond urban source areas.



Graph 3

CO emissions can create localized problems in areas prone to traffic congestion. Consideration of air quality in transportation planning at the state and county levels is necessary to prevent harmful concentrations of CO from accumulating in such areas.

RESULTS:

The primary air quality standard for CO is expressed in two forms: an 8-hour average value; and a 1-hour average value. Both are not to be exceeded more than once per year. Graph number 3 shows the 2nd highest 8-hour average concentrations for the six sites where CO was monitored in Kansas during 2000. All six sites were well below the 8-hour standard. The one hour monitoring results ranged from 5% to 20% of the standard. A graph for these results is not included in this report.

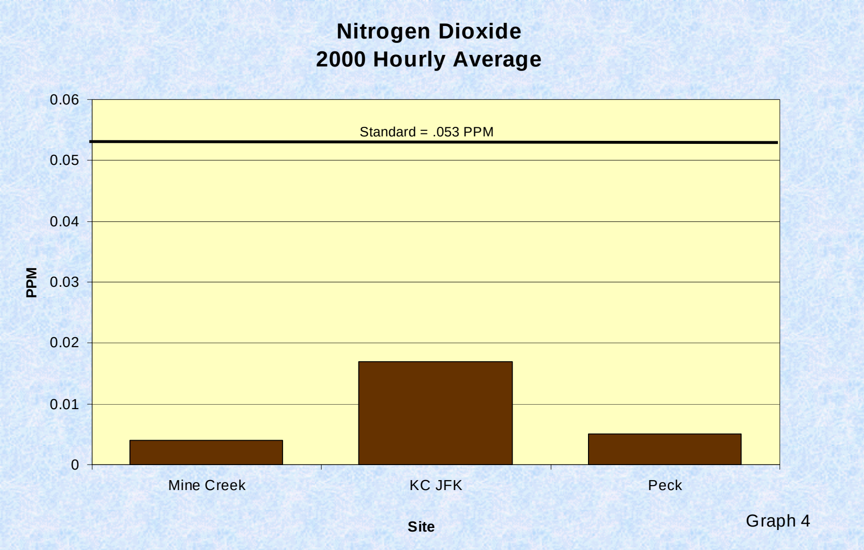
CO is a component of motor vehicle exhaust, which contributes about 60 percent of all CO emissions nationwide.

Nitrogen Dioxide (NO_2)

Nitrogen dioxide (NO_2) is one of the oxides of nitrogen that contribute to smog formation in urban areas. At a concentration of 1 ppm, NO_2 appears yellow-brown. In the atmosphere, NO_2 is partly converted to nitric acid and various particles that can also have adverse health and welfare effects.

Nitrogen dioxide is a pulmonary irritant that generally affects the upper respiratory system. The primary danger presented by oxides of nitrogen at concentrations found in urban areas, however, is associated with their role in the photochemical reactions that lead to ozone formation.

Natural sources of NO_2 include biological processes in soil and atmospheric oxidation of ammonia. On a global scale, NO_2 emissions from natural sources are approximately 10 times greater than emissions from man-made sources. This has little relevance to the problem of NO_2 and ozone formation because natural and man-made sources are generally separated geographically, with man-made sources concentrated in more populated areas. The major source of man-made NO_2 is fuel combustion in motor vehicle engines and utility or industrial boilers. Oxides of nitrogen are formed during high-temperature combustion by oxidation of atmospheric nitrogen, as well as (to a lesser extent) nitrogen in the fuel being burned. Most nitrogen oxides produced during the combustion process are in the form of nitric oxide(NO).



Graph 4

What Can I Do?

Here's how you can help protect clean air in Kansas.

On the road.......

- Take the bus, walk or ride a bike.
- Carpool to work.
- Drive your newest car... It has better air pollution controls.
- Keep your engine tuned.
- Check your emissions control system.
- Have your gas cap pressure checked for leaks.

Nitrogen oxides emitted from motor vehicles tend to disperse due to the small amount of emissions from each engine and the widespread nature of the emissions. Dispersion occurs more slowly when oxides of nitrogen are emitted from large stationary sources such as power plants with tall stacks, since the plume of hot gases rises and undergoes a gradual spreading due to winds and turbulence. In urban areas, NO_2 emitted near ground level becomes involved in ozone formation.

RESULTS:

The primary air quality standard for NO_2 is expressed in the form of an annual arithmetic mean. Graph number 4 shows the monitoring results for the three sites where NO_2 was monitored during 2000. All sites were well below the primary air quality standard of 0.053 ppm. The annual average concentration recorded at the Kansas City monitoring site was higher than the Mine Creek and Peck site due to its location in a metropolitan area.

Ozone (O_3)

Ground-level ozone (the primary constituent of smog) continues to be a pervasive pollution problem throughout many areas of the United States, including Kansas. Ground-level ozone is not emitted directly into the air but is formed by an atmospheric reaction, usually during hot summer weather. Ozone also plays a positive role. Stratospheric ozone, often referred to as "the ozone layer," prevents the harmful portion of the sun's ultraviolet radiation from reaching the surface of the earth. In this context, ozone is beneficial and protective of life on earth.


Photo by: K-State Research and Extension

Repeated exposures to ground level ozone can make people more susceptible to respiratory infection, resulting in lung inflammation. Other health effects attributed to ozone exposures include decreases in lung function and increased respiratory symptoms such as chest pain and cough. These effects generally occur while individuals are engaged in moderate or heavy exertion. Persons who are active outdoors during the summer when ozone levels are at their highest are most at risk of experiencing such effects. Other at-risk groups include individuals with pre-existing respiratory disease such as asthma and chronic obstructive lung disease.

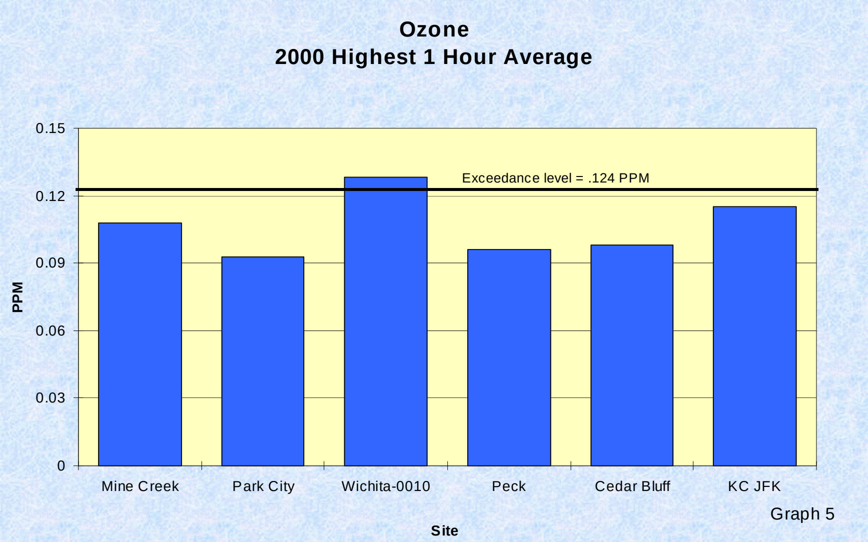
Ozone also affects vegetation and ecosystems, leading to reductions in agricultural and commercial forest yields, reduced growth and survivability of tree seedlings, and increased plant susceptibility to disease, pests, and other environmental stresses (e.g., harsh weather). Some plants such as white pine, wheat, tomatoes, milkweeds, soybeans, and alfalfa are especially sensitive to ozone and show damage at low levels. From the standpoint of crops critical to the Kansas economy, ongoing research indicates that ozone can cause significant reduction in yields of crops such as wheat and soybeans.


Photo by: Doug Watson, KDHE

Ozone is created by a complex series of chemical reactions in the atmosphere between NO_x and volatile organic compounds (VOCs) in the presence of sunlight. Man-made sources of oxides of nitrogen are emitted primarily from combustion sources. Man-made sources of VOCs include fuel combustion, fuel evaporation, painting, industrial and commercial applications using solvents. Natural sources of ozone precursors include VOCs emitted by certain plants and natural decay of biota in marshlands.

The rate of ozone formation is dependent upon temperature and intensity of sunlight. Ozone presents the greatest problem in urban areas on calm, hot, sunny summer days. In Kansas, the "ozone season" is considered to last from April 1 through October 31. Recent studies have demonstrated that ozone and its precursors may be transported through the atmosphere to add to problems in locations relatively far from their origin.

Where does ozone provide a protective layer high above the earth? a. mesosphere b. cosmosphere c. omnisphere d. stratosphere(Answer on inside back cover).



Graph 5

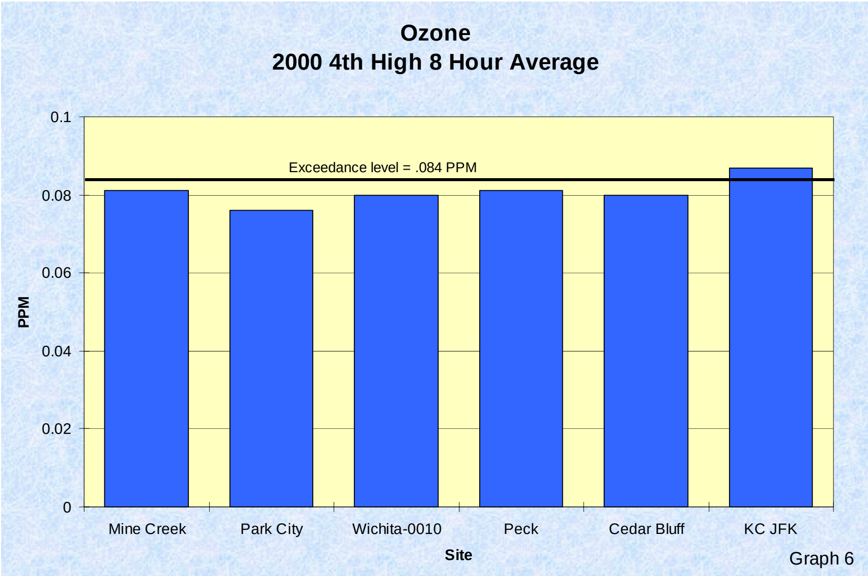
RESULTS:

The primary air quality standards for ozone are concentrations over either 8-hour or 1-hour durations. The 8-hour standard is expressed in the form of the three-year average of each year's 4th highest concentration. The 8-hour standard is 0.08 ppm. The standard is not exceeded until monitored values exceed 0.084 ppm, allowing for upward rounding. The 1-hour standard is not to be exceeded more than once per year on average. The 1-hour standard is 0.12 ppm. The standard is not exceeded until monitored values exceed 0.124 ppm, allowing for upward rounding.


Photo by: EPA

When evaluating ozone monitoring results, it is important to consider two points. First, monitoring results are rounded so a value can be slightly above the standard and not be considered a violation. Second, ozone values higher than the standard for one year do not always indicate a violation of the primary air quality standard. These determinations are made on the basis of three years of data.

Graph number 5 shows the highest 1-hour concentrations for the six sites where ozone was monitored in Kansas during 2000. With the exception of the Wichita site, the 1-hour results are below the standard. Graph number 6 shows the 4th highest 8-hour average concentrations for the same six sites. The 8-hour results show that all of the monitors are very close to or above the standard. Some of the ozone monitoring results will be discussed in greater detail in the sections of this publication dedicated to the Kansas City and Wichita metropolitan areas.



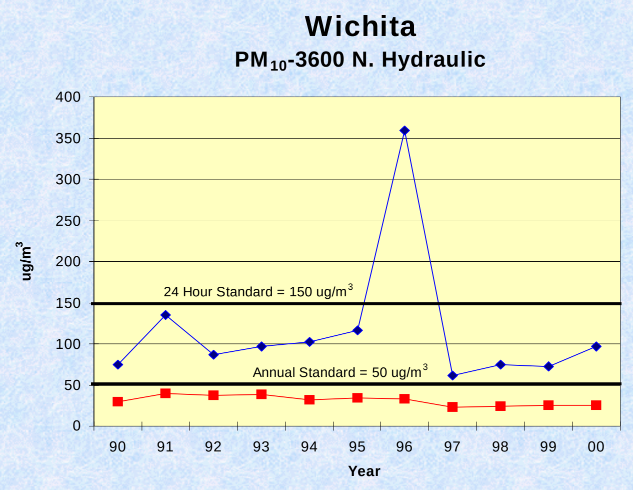
Graph 6

Particulate Matter (PM)

Particulate matter (PM) is the term used for a mixture of solid particles and liquid droplets found in the air. These particles come in a wide range of sizes. Some are large or dark enough to be seen as soot or smoke. Others are so small they can be detected only with a microscope. Particulate matter originates from many different stationary and mobile sources as well as from natural sources. Airborne particulate matter is designated as either PM_{10} or $PM_{2.5}$, also referred to as "fine" particulate matter. These designations are based on the diameter of the particles.

PM_{10}- Particulate matter with a diameter of less than or equal to 10 microns is designated as PM_{10}. Burning of wood, diesel and other fuels, and open burning contribute particulate matter to the atmosphere, generally in the form of smoke.

Certain industrial processes also generate PM_{10}. In addition, dust from agricultural operations, unpaved roads, and dust



1996 includes exceptional event data (high winds)

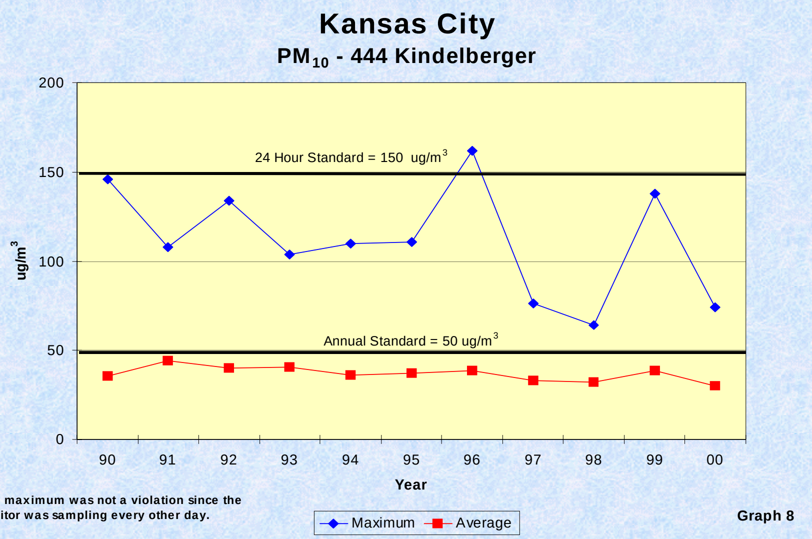
Graph 7

storms contains a significant proportion of PM_{10}. Some areas within the state of Kansas experience occasional severe episodes of blowing dust or dust storms.

Inhalation of PM_{10} can cause irritation of the nose and throat, bronchitis, and damage to lung tissue. Children, elderly persons, and individuals with impaired lung or heart function are especially susceptible to the adverse health effects associated with inhalation of airborne particulate matter.

Particulate matter suspended in the atmosphere also reduces visibility. Particulate matter can be transported great distances in the atmosphere. The smaller the particle, the greater the potential for aerial transport. During the "Dust Bowl Days" of the 1930s, dust clouds originating in Kansas and neighboring states were observed on the East Coast of the United States.

In addition to health problems, PM is the major cause of reduced visibility in many parts of the United States.



1996 maximum was not a violation since the monitor was sampling every other day.

Graph 8

During the first calendar quarter of 1996, high winds coupled with extremely dry soil conditions caused exceedances of the air quality standard for PM_{10} in Morton and Sedgwick Counties.

RESULTS:

Graph number 7 on page 20 shows the 11-year trend for PM_{10} monitored at the PM site at 3600 N. Hydraulic in Wichita. The annual average values have been stable over the eleven-year period and well below the annual standard. The year 1996 shows a high 24-hour PM_{10} value due to extremely dry weather and high winds noted above.

Graph number 8 shows the 11-year trend for PM_{10} at 444 Kindelberger in Kansas City. The annual average values also have been stable over the eleven-year period at this site. These values are also well below the annual standard. The year 1996 also shows an increase in PM values but they are not as pronounced as the values recorded at the Wichita site. Wind values were not as strong in the Kansas City area.

$PM_{2.5}$ - In 1997, EPA added a new particulate matter standard for particles with a diameter of less than or equal to 2.5 microns ($PM_{2.5}$). This change was based on concerns that smaller particles travel deep into the lungs and cause or aggravate respiratory problems such as asthma, and chronic bronchitis. Children, the elderly, and people with lung or heart disease are considered to be especially susceptible to the adverse health effects of airborne fine particulate matter.

Fine particles ($PM_{2.5}$) result from fuel combustion in motor vehicles, power generation, and industrial facilities, as well as from residential fireplaces and wood stoves. Research has shown that gases such as sulfur oxide and SO_2, NO_x, and VOC interact with other compounds in the air to form fine particles.

RESULTS:

The $PM_{2.5}$ standards issued by EPA in 1997 were set for two time periods, an annual average and a 24-hour average. The annual average standard was set at 15 micrograms per cubic meter (µg/m^3), while the 24-hour average standard was set at 65 µg/m^3. The $PM_{2.5}$ monitoring data will be evaluated over a three-year period to determine whether problems exist. This three-year period began in January 1999. Initial indications are that some urban areas may exceed the annual $PM_{2.5}$ NAAQS. With only two years of $PM_{2.5}$ data complete, it is too early to gauge the impact the new standard will have on Kansas. The table on page 22 lists the values of PM_{10} and $PM_{2.5}$ that were recorded across the state in 2000.

Particulate Matter Data - 2000

	PM_{10}		$PM_{2.5}$			PM_{10}		$PM_{2.5}$	
SITE	MAXIMUM (STD. = 150ug/m3)	AVERAGE (STD. = 50ug/m3)	98TH PERCENTILE (STD. = 65ug/m3)	AVERAGE (STD. = 15ug/m3)	SITE	MAXIMUM (STD. = 150ug/m3)	AVERAGE (STD. = 50ug/m3)	98TH PERCENTILE (STD. = 65ug/m3)	AVERAGE (STD. = 15ug/m3)
KANSAS CITY, KS / JOHNSON COUNTY					**WICHITA**				
420 KANSAS	138	37	N/A	N/A	13TH AND ST. PAUL	108	26	N/A	N/A
FAIRFAX	74	30	N/A	N/A	G. WASHINGTON & SKINNER	96	23	25.9	11.8
JFK COMM. CENTER	N/A	N/A	28.0	13.4	PAWNEE & GLENN	83	22	25.3	11.5
MIDLAND TRAIL ELEM.	N/A	N/A	26.2	11.0	HEALTH DEPARTMENT	95	24	26.4	11.9
OVERLAND PARK JUDICIAL CENTER	N/A	N/A	25.2	11.4	3600 N. HYDRAULIC	97	25	N/A	N/A
OXFORD MIDDLE SCHOOL	N/A	N/A	25.8	11.3	PECK (SUMNER CO.)	N/A	N/A	23.0	10.5
BLACK BOB ELEM. SCHOOL	N/A	N/A	25.4	11.1					
TOPEKA					**OTHER SITES**				
ROBINSON MIDDLE SCHOOL	51	20	23.5	10.7	DODGE CITY	49	22	N/A	N/A
WASHBURN UNIVERSITY	54	21	22.2	10.7	COFFEYVILLE	80	24	N/A	N/A
MCCLURE ELEM. SCHOOL	N/A	N/A	22.7	10.8	CHANUTE	82	26	N/A	N/A
					GOODLAND	79	25	N/A	N/A
					MINE CREEK (LINN CO.)	N/A	N/A	24.8	10.4

Ozone is formed by the interaction of volatile organic compounds and: a. NOx b. SOx c. ROcks